Integrative Structure Validation Report

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The following software was used in the production of this report:

IHMValidation Version 3.0
Python-IHM Version 2.5
MolProbity Version 4.5.2
pyHMMER Version 0.11.1

PDB ID	9A4K | pdb_00009a4k
PDB-Dev ID	PDBDEV_00000241
Structure Title	Integrative model of ACCD-ACCA by crosslinking MS and deep learning
Structure Authors	Stahl, K.; Brock, O.; Rappsilber, J.
Deposited on	2024-01-22

This is a PDB-IHM Structure Validation Report.

We welcome your comments at helpdesk@pdb-ihm.org

A user guide is available at https://pdb-ihm.org/validation_help.html with specific help available everywhere you see the ? symbol.

List of references used to build this report is available here.

1. Overview

1.1. Summary

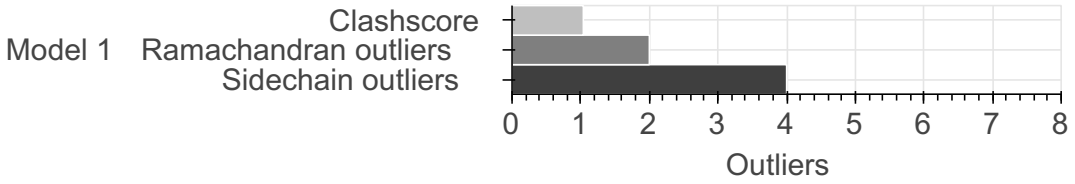
This entry consists of 1 model(s). A total of 1 dataset(s) were used to build this entry.

Name	Type	Count
Crosslinking-MS data	Experimental data	1

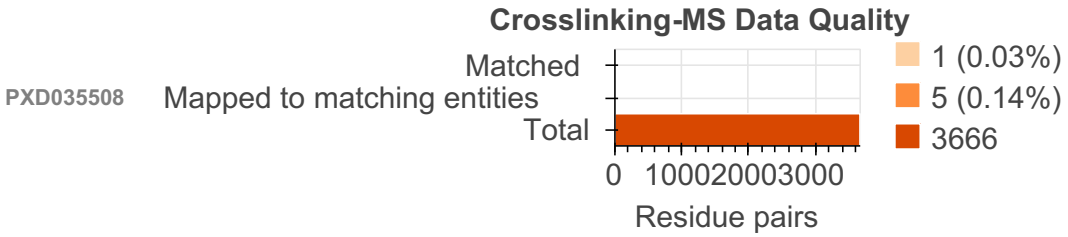
1.2. Overall quality

This validation report contains model quality assessments for all structures, data quality and fit to model assessments for SAS and crosslinking-MS datasets. Data quality and fit to model assessments for other datasets and model uncertainty are under development. Number of plots is limited to 256.

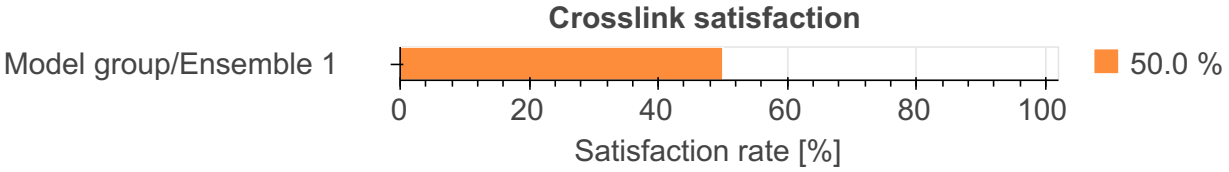
Model Quality: MolProbity Analysis



Data Quality



Fit to Data Used for Modeling



2. Model Details

2.1. Ensemble information

This entry consists of 0 distinct ensemble(s).

2.2. Representation

This entry has 1 representation(s).

ID	Model(s)	Entity ID	Molecule name	Chain(s) [auth]	Total residues	Rigid segments	Flexible segments	Model coverage/ Starting model coverage (%)	Scale
1	1	1	ACCD_BACSU	A	290	-	1-290	100.00 / 0.00	Atomic
		2	ACCA_BACSU	B	325	-	1-325	100.00 / 0.00	Atomic

2.3. Datasets used for modeling

There is 1 unique dataset used to build the models in this entry.

ID	Dataset type	Database name	Data access code
1	Crosslinking-MS data	PRIDE	PXD035508

2.4. Methodology and software

This entry is a result of 1 distinct protocol(s).

Step number	Protocol ID	Method name	Method type	Method description	Number of computed models	Multi state modeling	Multi scale modeling
1	1	AlphaLink2	AlphaLink2	Not available	1	False	False

There is 1 software package reported in this entry.

ID	Software name	Software version	Software classification	Software location
1	AlphaLink2	1.00	model building	https://github.com/Rappsilber-Laboratory/AlphaLink2

3. Data quality

3.2. Crosslinking-MS

At the moment, data validation is only available for crosslinking-MS data deposited as a fully compliant dataset in the PRIDE Crosslinking database. Correspondence between crosslinking-MS and entry entities is established using pyHMMER. Only residue pairs that passed the reported threshold are used for the analysis. The values in the report have to be interpreted in the context of the experiment (i.e. only a minor fraction of in-situ or in-vivo dataset can be used for modeling).

PXD035508

Number of entities in the crosslinking-MS dataset:	810
Number of entities in the entry:	2

Matching entities:

Entity ID	Molecule name	Crosslinking-MS Entity ID	E-value	Exact match
1	ACCD_BACSU	dbseq_C0SP93_target	0.00	True
2	ACCA_BACSU	dbseq_O34847_target	0.00	True

Residue pairs stats:

Source	Total	In matched entities	Total matched
9A4K	2	2 (100.00%)	1 (50.00%)
PXD035508	3666	5 (0.14%)	1 (0.03%)

4. Model quality

For models with atomic structures, MolProbity analysis is performed. For models with coarse-grained or multi-scale structures, excluded volume analysis is performed.

4.1b. MolProbity Analysis

Excluded volume satisfaction for the models in the entry are listed below. The Analysed column shows the number of particle-partice or particle-atom pairs for which excluded volume was analysed.

Standard geometry: bond outliers

There are no bond length outliers.

Standard geometry: angle outliers

There are 29 bond angle outliers in this entry (0.44% of 6547 assessed bonds). A summary is provided below.

Chain	Res	Type	Atoms	|Z|	Observed (Å)	Ideal (Å)	Model ID (Worst)	Models (Total)
A	237	GLN	OE1-CD-NE2	5.67	116.93	122.60	1	1
B	303	GLN	OE1-CD-NE2	5.33	117.27	122.60	1	1
A	289	GLN	OE1-CD-NE2	5.11	117.49	122.60	1	1
B	320	GLN	OE1-CD-NE2	4.91	117.69	122.60	1	1
B	304	GLN	OE1-CD-NE2	4.80	117.80	122.60	1	1
B	61	GLN	OE1-CD-NE2	4.75	117.85	122.60	1	1
B	26	GLN	OE1-CD-NE2	4.71	117.89	122.60	1	1
A	280	GLN	OE1-CD-NE2	4.69	117.91	122.60	1	1
B	105	HIS	CB-CG-CD2	4.66	125.15	131.20	1	1
B	173	GLN	OE1-CD-NE2	4.60	118.00	122.60	1	1
A	170	GLN	OE1-CD-NE2	4.59	118.01	122.60	1	1
A	114	LYS	CG-CD-CE	4.57	100.79	111.30	1	1
A	274	ASN	OD1-CG-ND2	4.55	118.05	122.60	1	1
A	80	GLN	OE1-CD-NE2	4.55	118.05	122.60	1	1
B	59	ARG	NH1-CZ-NH2	4.53	113.41	119.30	1	1
A	290	ASP	CA-CB-CG	4.45	117.05	112.60	1	1
A	73	GLN	OE1-CD-NE2	4.39	118.21	122.60	1	1
B	114	HIS	CB-CG-CD2	4.36	125.53	131.20	1	1
B	288	GLN	OE1-CD-NE2	4.33	118.27	122.60	1	1
A	193	GLN	OE1-CD-NE2	4.29	118.31	122.60	1	1
A	152	LYS	CG-CD-CE	4.25	101.52	111.30	1	1
A	53	ASN	OD1-CG-ND2	4.22	118.38	122.60	1	1
B	272	HIS	CB-CG-CD2	4.22	125.71	131.20	1	1
A	264	HIS	CB-CG-CD2	4.20	125.74	131.20	1	1
A	120	HIS	CB-CG-CD2	4.19	125.76	131.20	1	1

Chain	Res	Type	Atoms	|Z|	Observed (Å)	Ideal (Å)	Model ID (Worst)	Models (Total)
B	273	HIS	CB-CG-CD2	4.07	125.91	131.20	1	1
B	115	GLN	OE1-CD-NE2	4.05	118.55	122.60	1	1
A	19	GLN	OE1-CD-NE2	4.05	118.55	122.60	1	1
B	47	GLN	OE1-CD-NE2	4.01	118.59	122.60	1	1

Too-close contacts

The following all-atom clashscore is based on a MolProbity analysis. All-atom clashscore is defined as the number of clashes found per 1000 atoms (including hydrogen atoms). The table below contains clashscores for all atomic models in this entry.

Model ID	Clash score	Number of clashes
1	1.04	10

There are 10 clashes. The table below contains the detailed list of all clashes based on a MolProbity analysis. Bad clashes are >= 0.4 Angstrom.

Atom 1	Atom 2	Clash(Å)	Model ID (Worst)	Models (Total)
A:174:LEU:HD23	B:259:ILE:HD11	0.58	1	1
A:200:MET:HE2	A:213:ALA:O	0.58	1	1
A:152:LYS:HE3	A:192:GLU:CD	0.54	1	1
B:167:ALA:HB1	B:171:ARG:HH12	0.53	1	1
A:80:GLN:HB2	B:321:TYR:CE1	0.51	1	1
B:265:LYS:HE3	B:281:TYR:CZ	0.45	1	1
B:167:ALA:HB1	B:171:ARG:NH1	0.45	1	1
B:69:PRO:HG3	B:275:VAL:HG22	0.42	1	1
A:48:MET:HE1	A:266:ASP:HA	0.42	1	1
B:215:MET:SD	B:254:LEU:HD22	0.41	1	1

Torsion angles: Protein backbone

In the following table, Ramachandran outliers are listed. The Analysed column shows the number of residues for which the backbone conformation was analysed.

Model ID	Analysed	Favored	Allowed	Outliers
1	611	581	28	2

There are 2 unique backbone outliers. Detailed list of outliers are tabulated below.

Chain	Res	Type	Models (Total)
A	9	LYS	1
A	109	ALA	1

Torsion angles : Protein sidechains

In the following table, sidechain rotameric outliers are listed. The Analysed column shows the number of residues for which the

sidechain conformation was analysed.

Model ID	Analysed	Favored	Allowed	Outliers
1	515	498	13	4

There are 4 unique sidechain outliers. Detailed list of outliers are tabulated below.

Chain	Res	Type	Models (Total)
A	2	LEU	1
A	55	ASP	1
A	108	GLU	1
A	285	ILE	1

5. Fit to Data Used for Modeling Assessment

5.2. Crosslinking-MS

5.2.1. Restraint types

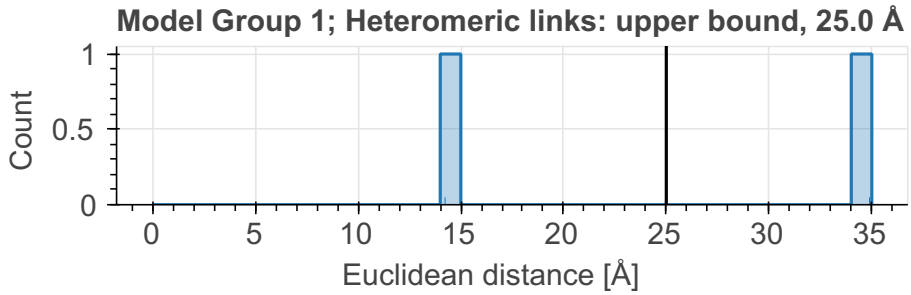
This table summarizes information about crosslinker(s) used for data generation, and how crosslinking information was translated into actual modeling restraints. Restraints assigned "by-residue" are interpreted as between CA atoms. Restraints between coarse-grained beads are indicated as "coarse-grained". Restraint group represents a set of crosslinking restraints applied collectively in the modeling.

There are 2 crosslinking restraints combined in 2 restraint groups.

Linker	Residue 1	Atom 1	Residue 2	Atom 2	Restraint type	Distance, Å	Count
SDA	LYS	CA	LYS	CA	upper bound	25.00	2

Distograms of individual restraints

Distograms (i.e., histogram plots of distances) provide an overview of distributions of distances between residues for which chemical crosslinks were identified. The shift of the distogram relative to the threshold value may indicate a poor model. Restraints with identical thresholds are grouped into one plot. Only the best distance per restraint per model group/ensemble is plotted. Inter- and intramolecular (including self-links) restraints are also grouped into one plot. Distance for a restraint between coarse-grained beads is calculated as a minimal distance between shells; if beads intersect, the distance will be reported as 0.0. A bead with the highest available resolution for a given residue is used for the assessment.



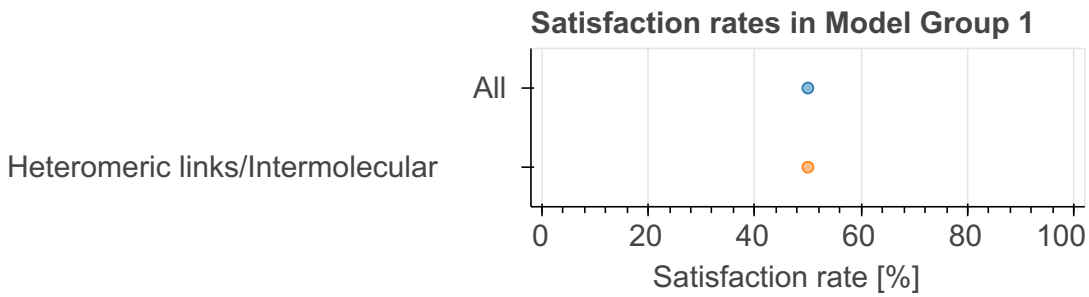
5.2.2. Satisfaction of restraints

Satisfaction of restraints is calculated on a restraint group (a set of crosslinking restraints applied collectively in the modeling) level. Satisfaction of a restraint group depends on satisfaction of individual restraints in the group and the conditionality (all/any). A restraint group is considered satisfied, if the condition was met in at least one model of the model group/ensemble. The number of measured restraints can be smaller than the total number of restraint groups if crosslinks involve non-modeled residues. Only deposited models are used for validation right now.

State group	State	Model group	# of Deposited models/Total	Restraint group type	Satisfied (%)	Violated (%)	Count (Total=2)
1	1	1	1/1	All	50.00	50.00	2
				Heteromeric links/ Intermolecular	50.00	50.00	2

Per-model satisfaction rates in ensembles

Every point represents one model in a model group/ensemble. Where possible, boxplots with quartile marks are also plotted.



6. Fit to Data Used for Validation Assessment

Validation for this section is under development.

Acknowledgments

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